Joint Distributed Engineering Plant

NDIA Systems Engineering Conference
Industry Roundtable

Purpose

- **Purpose**
  - Provide an update on status of the Joint Distributed Engineering Plant
  - Share plans for the development of JDEP and implementation of JDEP strategy
  - Discuss options for industry roles and participation in JDEP as well as industry responses to JDEP

Topics

- What is JDEP?
- Background and Motivation
- Progress of Initial Year
- JDEP Strategy
- Current Status
- Implementing the Strategy
- Relationship Among HWIL, Simulation and Live Ranges in JDEP
- Challenges Facing JDEP
- Industry Discussion

What is JDEP?

Joint Distributed Engineering Plant (JDEP) Defined

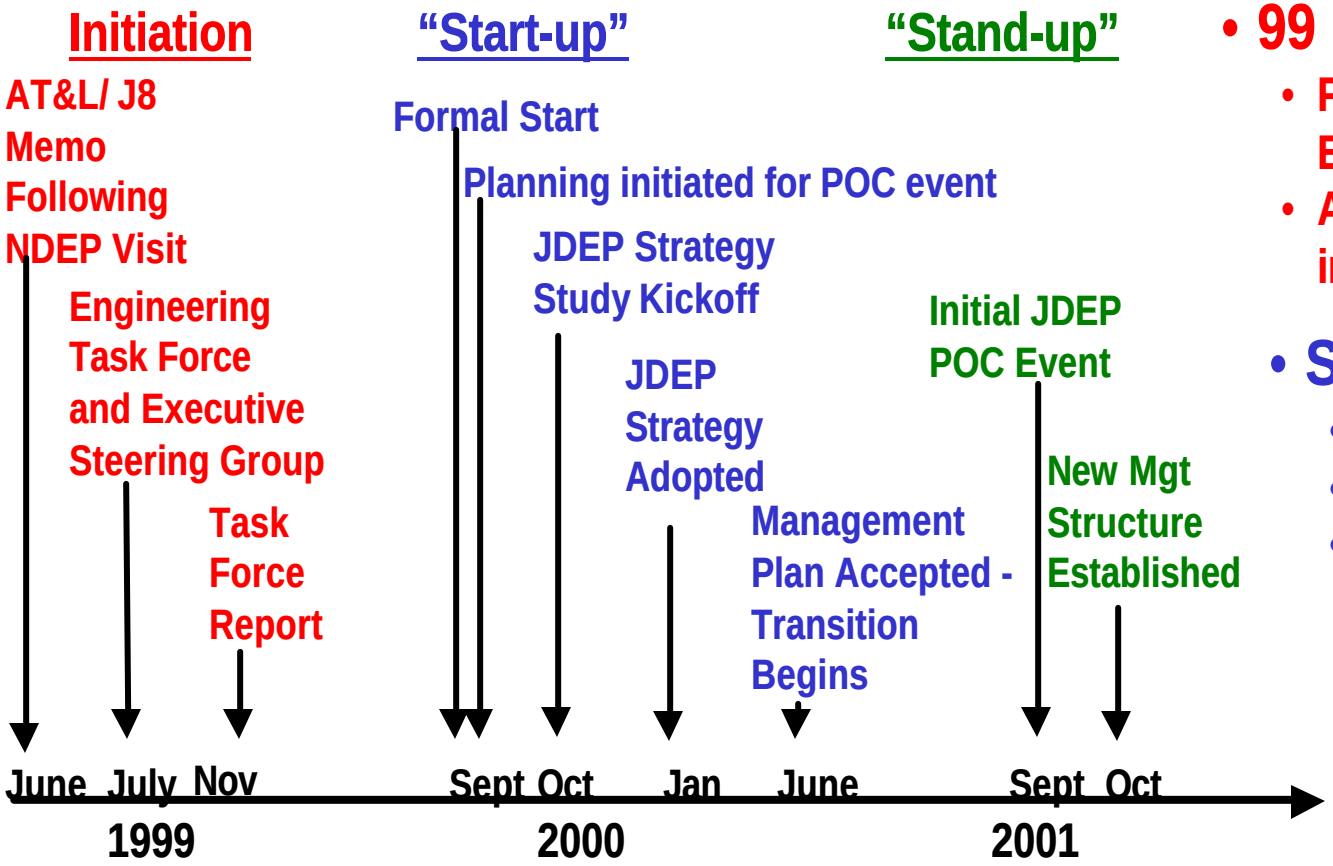
" The JDEP program was established as a DoD-wide effort to link existing service and joint combat system engineering and test sites (including design activities, software support activities, test and evaluation facilities, training commands, and operational units). JDEP is designed to improve the interoperability of weapon systems and platforms through rigorous testing and evaluation in a replicated battlefield environment. "

[DPG Update FY 2002-2007, Guidance, p.112]

The Big Idea

- Doctrine and operations are increasingly dependent on Joint SoS
- This demands new approaches to SoS development, integration, test and assessment
- JDEP addresses this need by providing users with the means to create SoS environments by linking existing, distributed system HWIL assets
- Assets, built and used for individual system development and test, are shared and applied in different configurations to address SoS
- JDEP supports users to identify the right resources, to configure resources to address interoperability issues, providing access to common reusable assets (networks, security devices, scenarios, etc.)

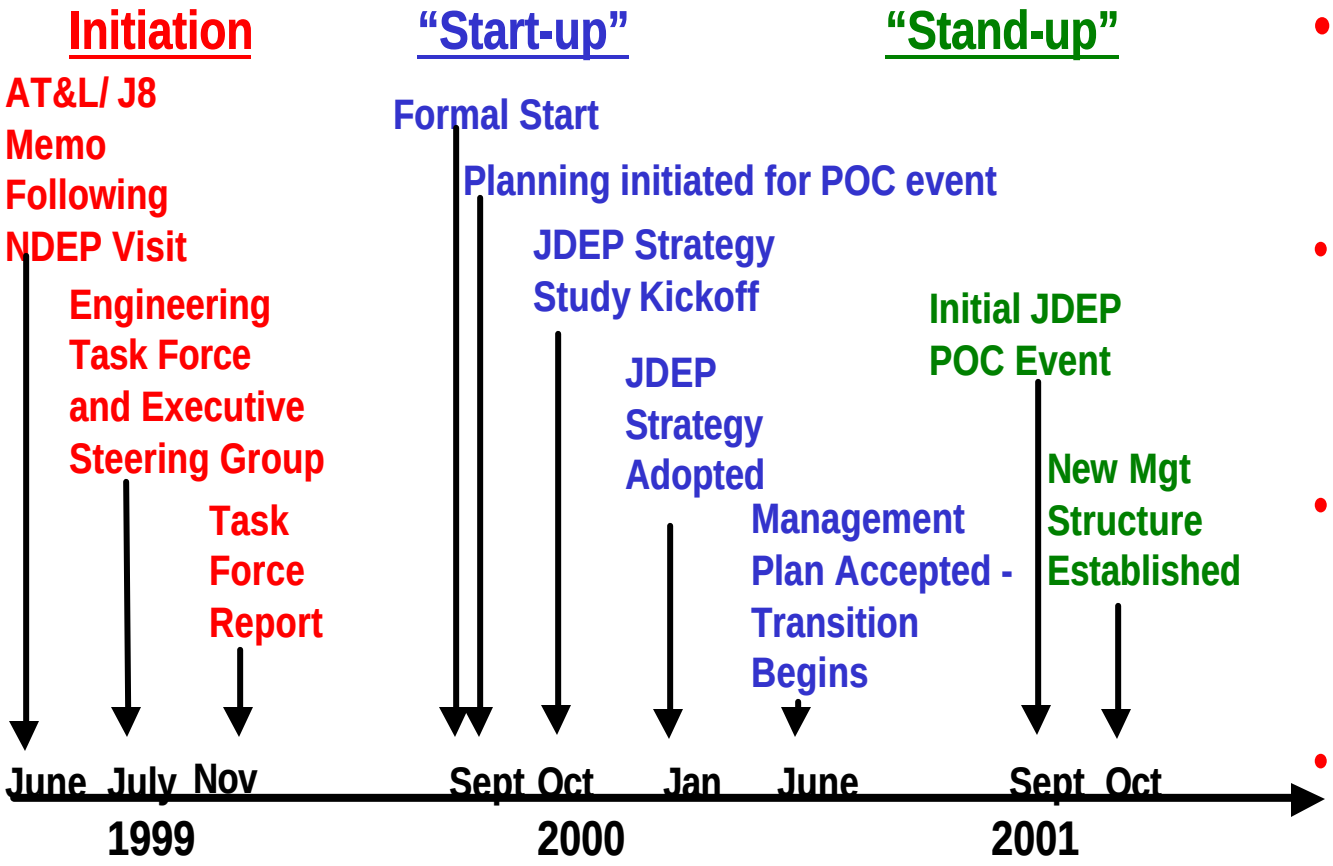
JDEP Major Milestones



- **99 Memo creates JDEP**
  - Formed Steering Group & Engineering Task Force
  - Adopted initial plan for JDEP implementation with JTAMD
- **Sept 00 Program Start**
  - JTAMD Interim Manager
  - POC Event Planning
  - JDEP Strategy Adoption
- **Current Status**
  - POC Event Executed
  - New Management Structure In Place
  - FY02 + Planning

Background and Motivation

JDEP Initiation



- 99 Memo creates JDEP
- **Formed Steering Group & Engineering Task Force for initial planning**
- **Adopted initial plan for JDEP implementation with JTAMD**
- **Addressed scope, funding, and early management structure**

JDEP Motivation

- JDEP was initiated based on a memorandum
  - **From Principal Deputy USD/AT&L and the Director, Force Structure, Resources and Assessment, JS/J8**
  - **“ We believe an approach taken by the Navy to use a land-based distributed engineering plant (DEP) to address integration and interoperability problems for the fleet (air and missile defenses) may be an appropriate concept to address joint interoperability issues (collaboratively) between all services” (2 June 1999)**
- Memo stood up a GOFSG with tasks to
  - **Set up and charter a Joint Engineering Task Force (JETF)**
  - **Oversee and assess JETF efforts to**
    - **Develop the approaches and costs to construct a Joint DEP**
    - **Recommend how to best proceed**
    - **Build consensus and establish ownership**

Navy DEP Background

- DEP is a Navy initiative
- Responded to recognized need for air defense System of System engineering and testing of Battle Group (BG) Systems prior to deployment (D-Day)
- A component of ‘D Minus 30’ process of BG deployment
- Distributed, land-based systems Hardware (HW) and Software (SW); integrated over a network for interoperability testing
- Results documented in ‘Capabilities and Limitations’ document which accompanies deployed BG systems to inform users
- By CNO policy - successful DEP testing is a prerequisite to BG deployment.

JDEP GOFSG and JETF Goal and Tasking

- Collective goal of GOFSG and JETF was to establish a "Joint Alliance" that would
  - **Finalize design and build a joint prototype "Plant"**
  - **Develop a joint test plan and procedures**
  - **Validate network, simulation/stimulation, and a joint "Plant"**
  - **Conduct joint interoperability tests**
  - **Perform data management and analysis**

  [JETF Final Report V1,4]
- JETF Task
  - **"… develop the approaches and costs necessary to construct a Joint Distributed Engineering "Plant" (JDEP) that leverages systems from all the Services to support Joint Force interoperability"**

    [GOFSG Memo, 2 June 1999]

Initial JDEP Purpose in JETF Report
[JETF Final Report, p. 196, 15 November 1999]

- **Threshold "warfighter, current systems focus"**
  - **Joint Force interoperability testing of currently and soon-to-be fielded JTAMD Family of Systems (FoS)**
    - **Identify and fault isolate interoperability problems**
  - **Joint Force interoperability system engineering to design, develop, and test near-term interoperability fixes**
- **Objective "developing systems focus'**
  - **Joint Force TAMD FoS interoperability system engineering**
    - **Design, develop, and test longer term interoperability fixes**
    - **FoS effectiveness to assess operational benefits of interoperability (low fidelity endgame modeling)**
    - **FoS effectiveness to assess full end-to-end performance (low fidelity endgame modeling)**
  - **Joint Force TAMD FoS interoperability requirements development**

Defense Planning Guidance

[DPG Update FY 2002-2007, Guidance, p.112]

8. (U) **Joint Distributed Engineering Plant (JDEP).** The JDEP program was established as a DoD-wide effort to link existing service and joint combat system engineering and test sites (including design activities, software support activities, test and evaluation facilities, training commands, and operational units). JDEP is designed to improve the interoperability of weapon systems and platforms through rigorous testing and evaluation in a replicated battlefield environment. PBD 725 provided a $45 million downpayment across the FYDP to establish the JDEP in phases. The Services shall program the balance of the Joint Engineering Task Force estimate consistent with this phased approach.

JDEP Major Milestones
Prior to Formal Program Initiation

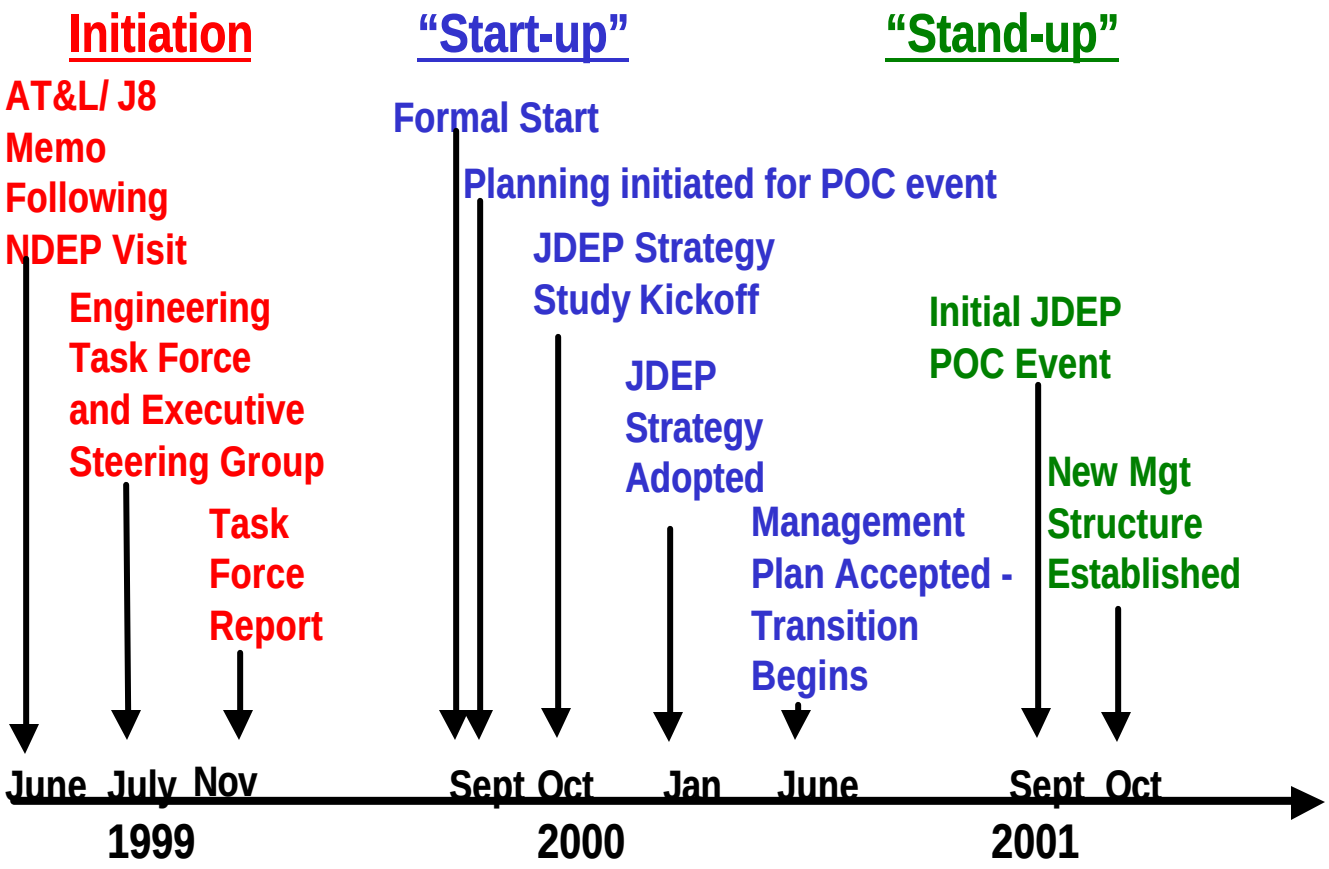
- 2 June 1999 — Initiating memo forming GOFSG
- 28 June 1999 — GOFSG Meeting
- 30 June 1999 — JETF established
- 5 Aug 1999 — GOFSG Meeting
- 23 Aug 1999 — GOFSG Meeting
- July-Oct 1999 — JETF proceedings
- 15 Nov 1999 — JETF Report published
- 9 March 2000 — GOFSG Meeting
- 7 Feb 2000 — JROC JDEP Presentation
- 14 April 2000 — GOFSG Meeting
- 16 May 2000 — GOFSG Meeting
- 11 July 2000 — GOFSG Meeting

Scoping of JDEP Development Plans

- JETF proposed a large multi-site, multi-year development with incremental builds
  - **Large scope, high costs were an inhibitor to participation**
- March 00 GOFSG: Guidance to use DoD technical architecture for simulation, HLA, in JDEP to support distribution of test scenario events to distributed system stimulators
- April 00 GOFSG: Rescoped development effort proposed
  - **Small initial event proposed as first step; add one AF (AWACS) and one Army system (Patriot) and one E2C to DEP subset (Navy AEGIS); SIAP SE as user**
  - **Revised costs for expanded JDAMD JDEP implementation**
- Recognition that JTAMD was initial focus; long-term goal was extension of JDEP beyond JTAMD to other mission areas and application of JDEP to broader interoperability issues

Progress Made In Initial Year

JDEP Major Milestones

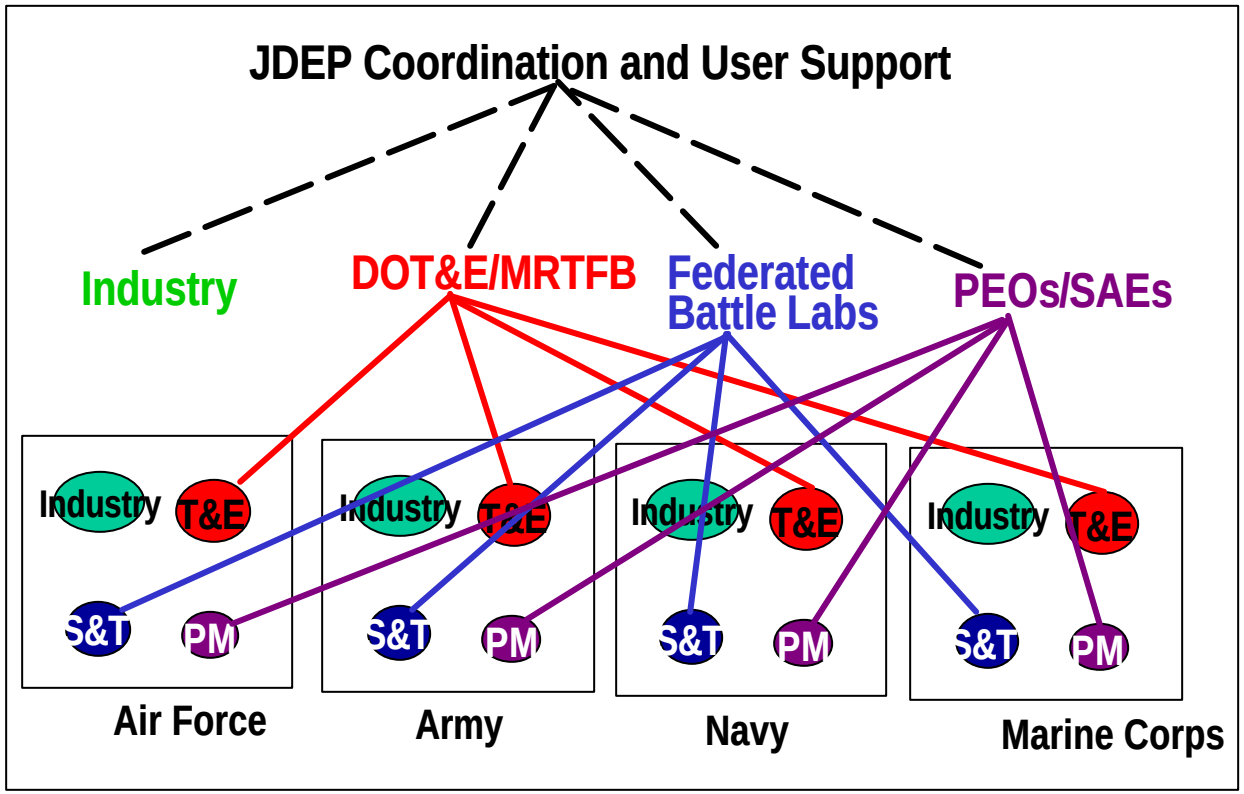


- Sept 00 program start
- JTAMDO acts as Interim Manager
- POC Event Planning
- Adoption of JDEP Strategy to guide long-term operations and management

Three Track FY01 Implementation Approach

- In FY 01 JDEP was considered in three **tracks**:
  - Track 1: JDEP TAMD Initial **Event**; limited build to establish JDEP concept
    - **Four system implementation to demonstrate concept and provide useful results to SIAP system engineer**
  - Track 2: **Expand** implementation to address broader JTAMD issues
    - **Based on lessons learned from track 1, add systems and sites to support JTAMD integration and interoperability testing**
  - Track 3: **Extend** JDEP beyond JTAMD to other mission areas
    - **Begin in parallel with Tracks 1/2 to extend JDEP to meet the similar needs of other mission areas**

Broader Purposes of JDEP



- JDEP will support three types of users
  - **Developers to engineer interoperability into systems**
  - **Testers to test and evaluate interoperability among systems**
  - **War fighters to assess operational capabilities of forces**

- By providing technical support to identify, access, and configure HWIL and SWIL federations of SoS to meet users' needs

JDEP Strategy

JDEP Strategy - Capabilities and Events

- JDEP capabilities are
  - HWIL/SWIL assets and processes,
  - owned by different organizations,
  - reused in different federations to address different SoS issues,
  - 'coordinated centrally' to support reuse and access by multiple users for different purposes

Common across JDEP users; how they are used and purpose varies

- JDEP events
  - occur whenever JDEP components are 'federated' may be large or small with multiple events running concurrently
  - may not be a single event, but rather an ongoing event series

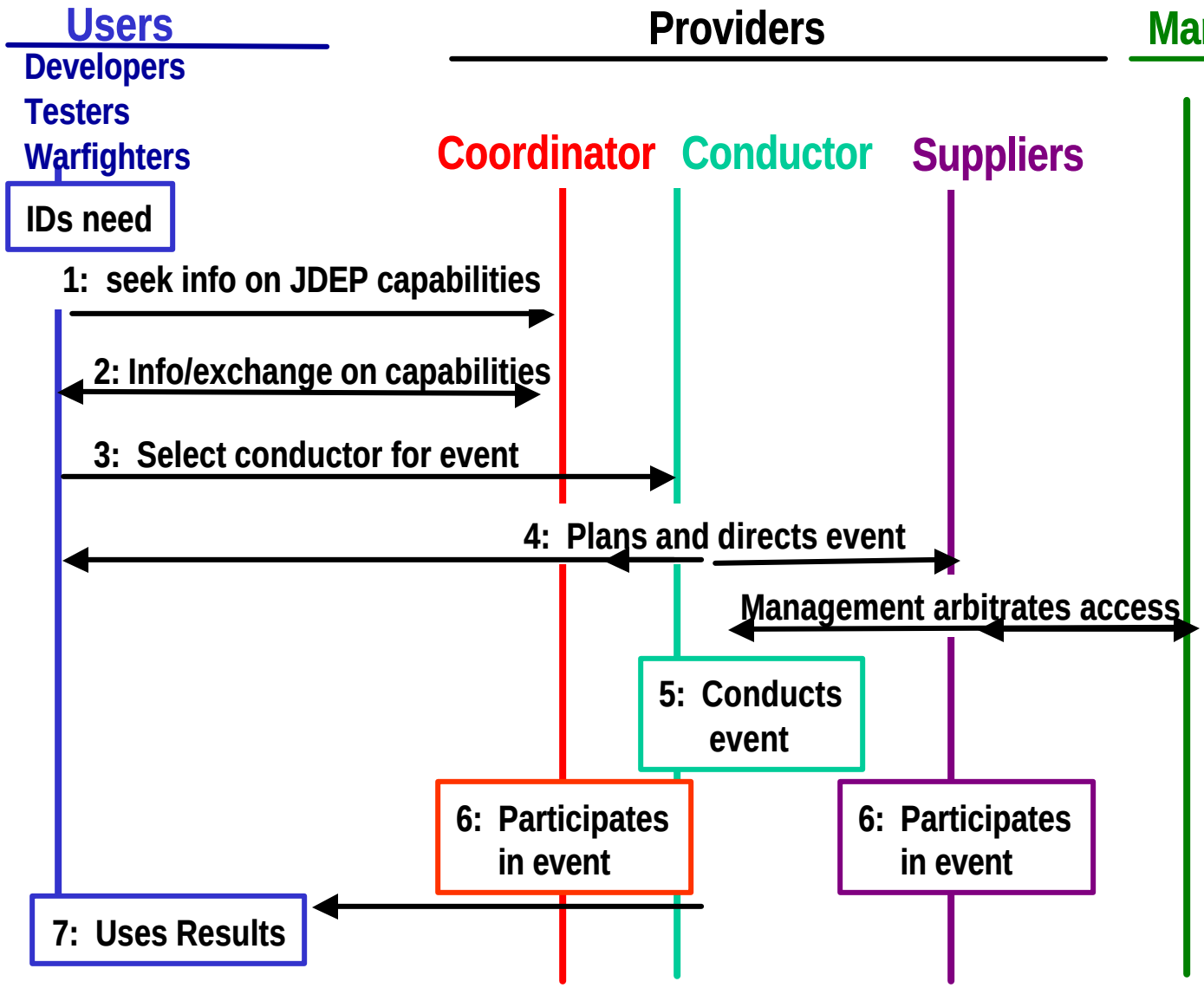
JDEP Strategy - Participants

- JDEP users define the problems to be addressed by the JDEP federation and applies the results to meet their needs
- JDEP providers support users in several ways
  - Coordination and technical support organization **helps users to identify, access, and configure assets and provides common tools and processes to meet their SoS needs**
  - Event conductors **direct specific events on behalf of users**
  - Suppliers **share their assets with different users to address SoS issues**
- JDEP management looks across all JDEP uses and events to
  - **Provide infrastructure investment,**
  - **Oversee asset coordination, and**
  - **Arbitrate access to scarce resources**

JDEP Strategy - Technical Framework

- JDEP technical framework defines how components are 'composed' to create a 'federation' including
  - **The types and functions of components**
  - **The interfaces between components**
  - **Guidance on how to configure components into federations**
- Today different communities use different approaches
  - **Include, among others, Navy DEP, BMDO 'TMDSE', 'D-Net', TENA**
- JDEP challenge is to define a framework to bridge communities
  - **Sufficient structure and standardization to get efficiency through ease of reuse and reconfigurability and**
  - **Sufficient flexibility to support different user needs and accommodate legacy capabilities with realistic investment**

‘Steady State’ CONOPS for a JDEP Event



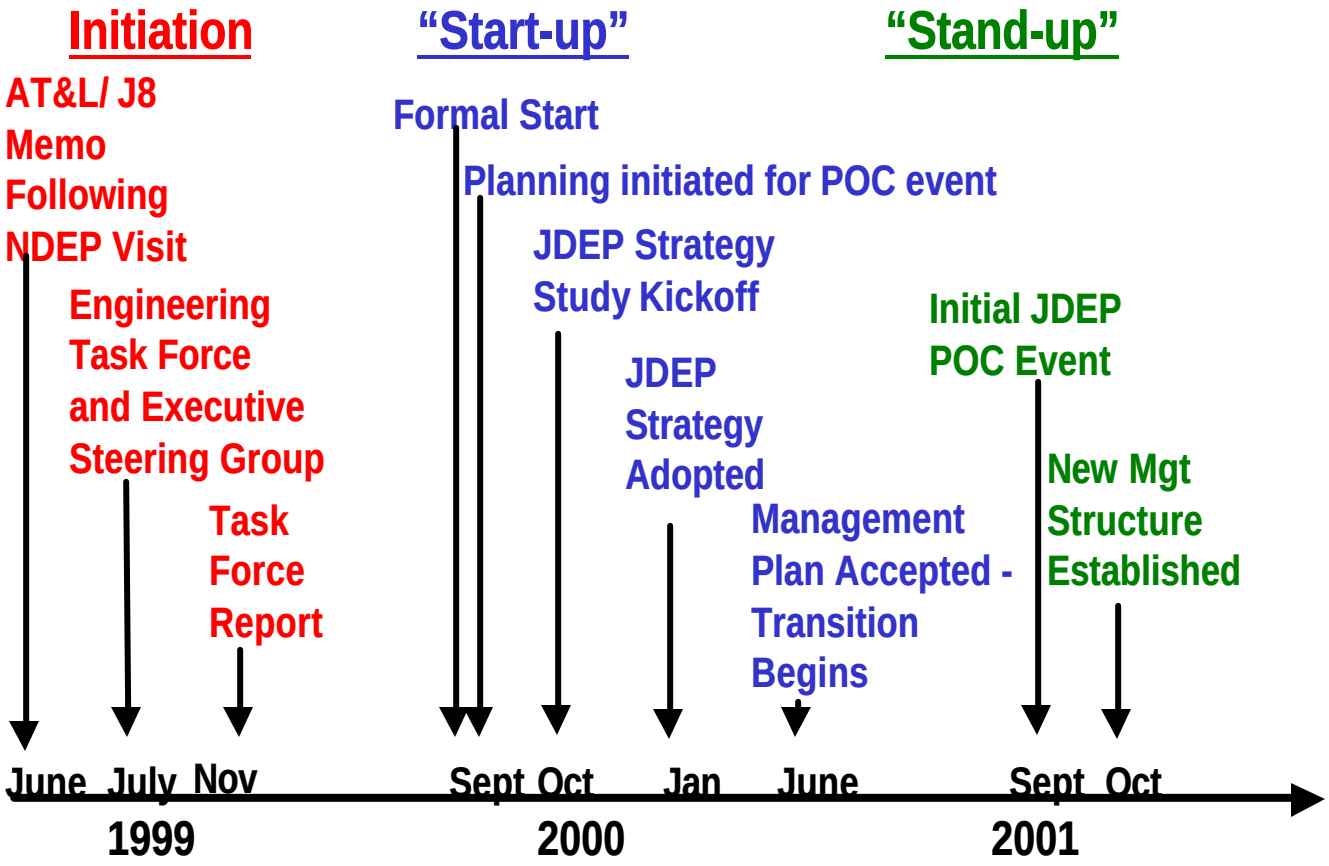
Strategy describes general roles, relationships and actions of key JDEP participants

Key Actions

- January 00 Executive Steering Group (ESG) adopted JDEP Strategy
- IPTs created to implement strategy through proposed management structure and event planning
- Management structure was accepted in July 00, plans were developed to implement this structure
- Candidate FY02 events were proposed and assessed

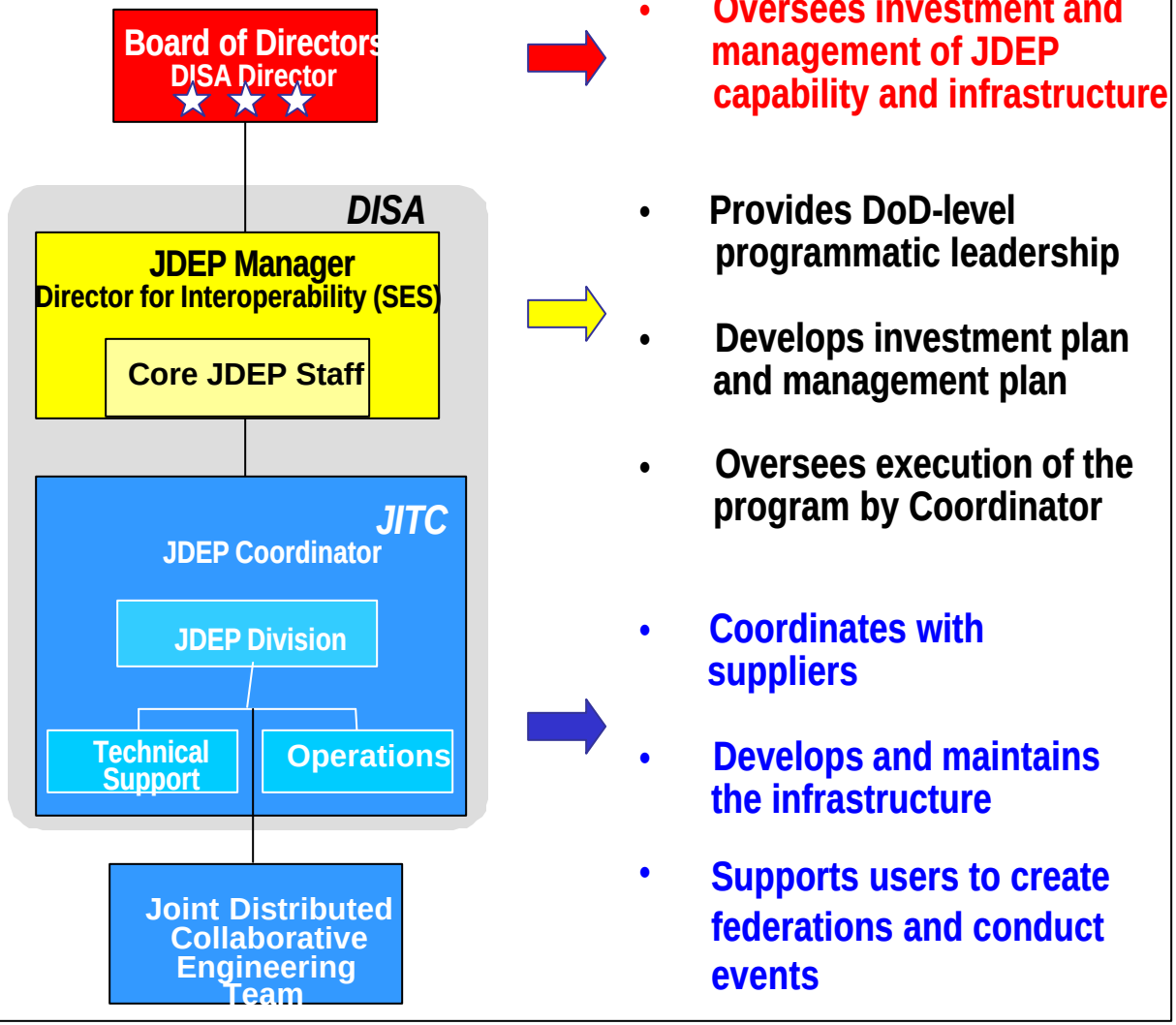
Current Status

Stand Up



- **Current Status**
  - **POC Event Executed**
  - **New Management Structure In Place**
  - **FY02 + Planning**

JDEP Management Structure



- Single management structure supporting multiple user communities
- Users (PMs, test agencies, etc) work within their existing structures to conduct events with JDEP support to meet their needs
  - **JNTF will coordinate JTAMD applications of JDEP**

JDEP Proof of Concept Event

- Initial planning based on
  - **Use of NDEP process to produce 'Caps and Lims'**
  - **Reuse NDEP network, scenarios, data collection and analyses**
  - **Limited funding**
- SIAP SE selected customer
  - **Required rethinking**
  - **Placed constraints on event due to schedule and funding**

- Event objectives
  - **Characterize performance against with SIAP metrics**
  - **Identify added capabilities needed for SIAP follow-up analysis**
  - **Develop JDEP process**
- Event was executed in September; analysis underway

Planning for FY02 and Beyond

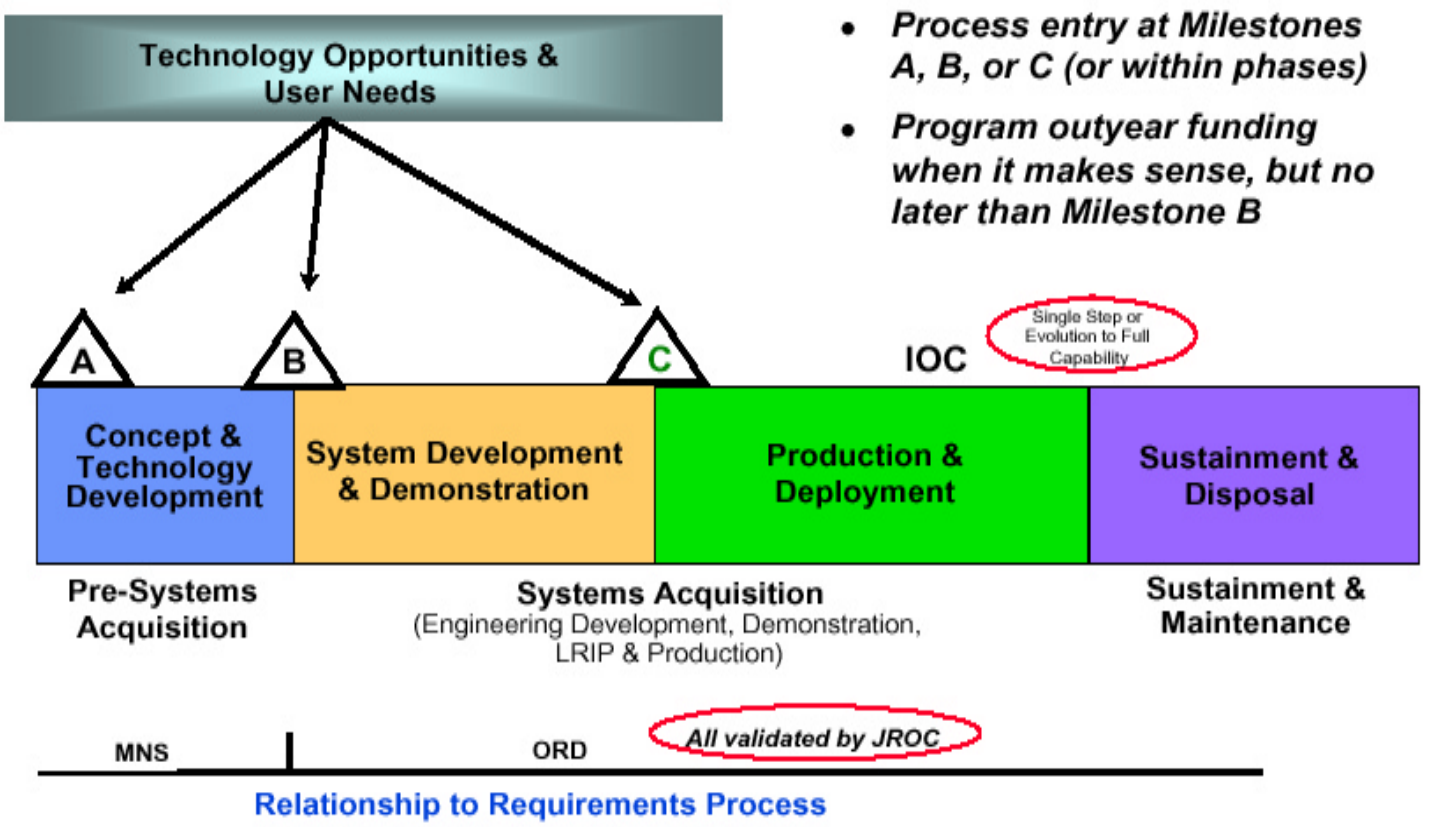
- A JDEP implementation plan is in development by DISA and JITC
- Planning for FY02 events are underway JNTF, JITC and the Services
- New partnerships are being created
  - DOT&E: TENA and INTERTEC
  - JT&E: Joint Interoperability Interoperability Test Methodology (JITM)
  - ASD C3I C4ISR Decision Support Center: Study on application of JDEP to C2
  - and more….

Implementing Strategy

Applying JDEP to DOD SoS Issues?

- SoS requirements are growing and there is a need, driven by policy and regulation, to address SoS integration and interoperability issues throughout the lifecycle
  - **From initial requirements definition through fielded system upgrades**
- In selected areas (notably, Joint Theater Missile Defense), there are organizations designated to address SoS responsibilities
- Beyond this, however, SoS responsibilities are distributed across multiple organizations
- JDEP provides the means for these different organizations to access and apply capabilities to address the integration and interoperability needs of this diverse set of potential users

Process in 5000.1 Instruction



- There are DoD requirements to address interoperability at each milestone (A, B, and C)

What are the near-term applications of JDEP?

1 Developers and testing of new systems
   - **to integrate or test interoperability of new systems**
   - **as part of the development process to assess interoperability requirements, KPPs, C4ISP support plans throughout the life cycle**
   - **in support of system test and evaluation, or**
   - **as a 'pre-deployment' checkout**

2 Support interoperability fixes to deployed systems
   - **to identify interoperability problems among deployed systems now being used in a new way or**
   - **to integrate and test fixes to these systems**

3 To assess SoS capabilities in mission areas
   - **to support assessment of systems of systems issues in joint mission areas**
   - **to support war fighters in assessing system of system capabilities**

JDEP for New Systems

- JDEP capabilities can be used to integrate or test interoperability for new systems
  - **DoD policy calls for definition and support of interoperability throughout the life cycle**
  - **Once a system has an initial HW/SW development, JDEP could be used to support integration or verification of interoperability with end items**
    - **as part of the development process,in support of system test and evaluation, or as a 'pre-deployment' checkout**
  - **When simulated system representations are available early, initial simulation-based efforts can be used as a base for later HWIL testing**
- Supports current policy on interoperability KPPs and C4ISP support plans
- As systems mature, a viable 'common environment' will be needed to support interoperability testing; without this individual PMs will create their own environments for their own needs, leading to
  - **no reduction in incremental cost with each new system and no assurance that overall systems will be interoperable**

JDEP for Legacy System Fixes

- JDEP will support interoperability of deployed systems to meet user needs
  - **to identify interoperability problems among deployed systems now being used in a new way or**
  - **to integrate and test fixes to these systems**
- Support current Joint integration and interoperability processes
  - **JFCOM Joint Integration and Interoperability Process (JI&I Process**)
- Recent action (Wolfowitz Letter) to improve interoperability of legacy systems envisions JDEP as a core support resource

JDEP for Joint SoS

- JDEP could be used to address Joint SoS issues in joint mission areas
  - **to support assessment of systems of systems issues in joint mission areas**
  - **such as JTAMD and others as they evolve**
- As areas of specific joint interest are identified (e.g. time critical targets), environments will be required to assess the extent to which current system capabilities meet need of joint operations and to test new capabilities as they emerge

Building up JDEP Applications

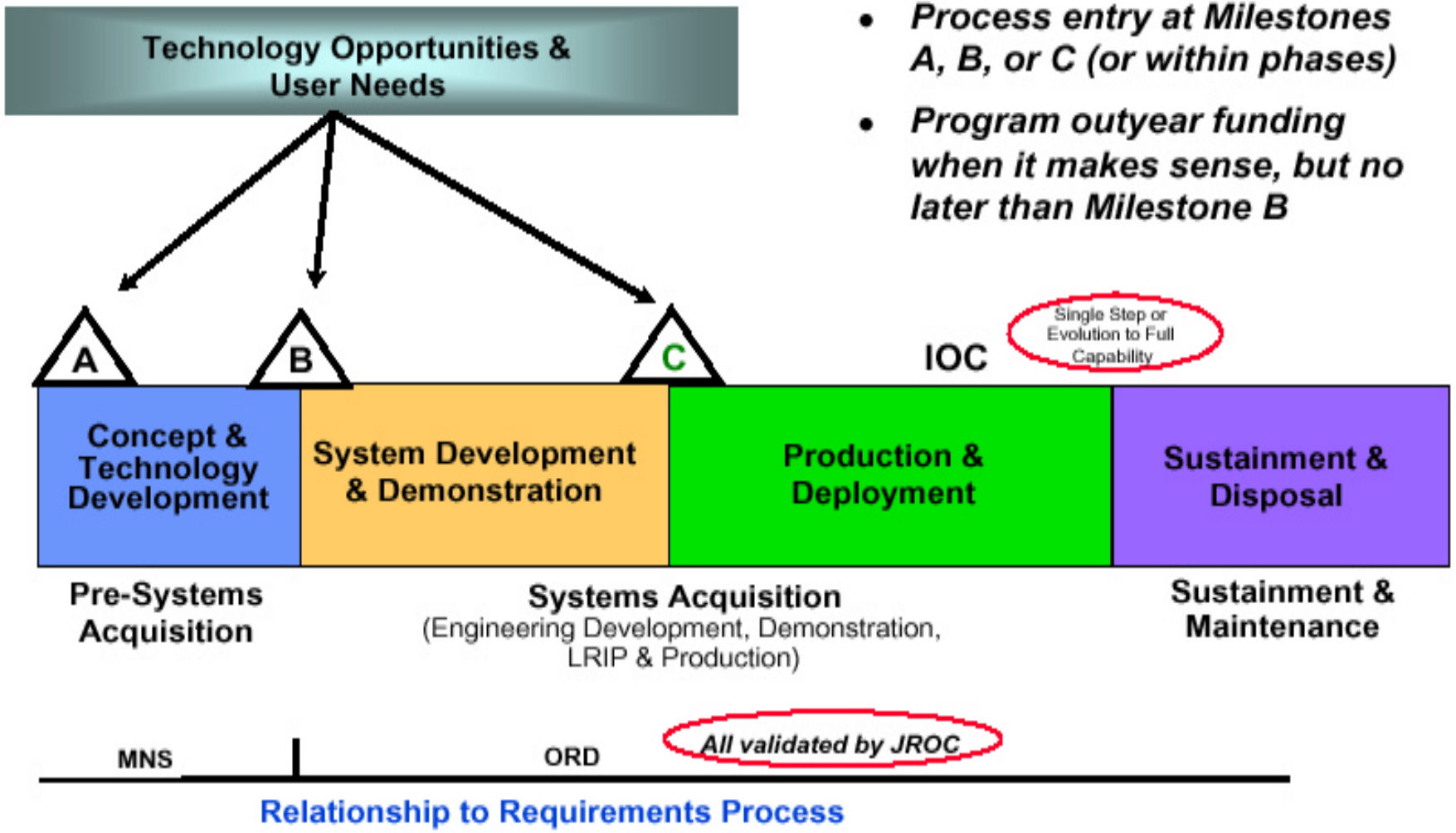
- Strategy is framed in broad terms, looking at JDEP in the 'objective' or steady-state case, where JDEP will serve a broad range of users
- It is recognized that implementing this strategy will be an incremental, phased process
  - **Established areas such as JTAMD will be leaders**
  - **Other established, related areas (e.g. joint interoperability certification) will be 'adopted' into the JDEP enterprise adding more capabilities for reuse**
  - **Available 'capabilities' will be identified and added to the inventory for potential reuse by others**
- As priority application areas (Legacy system interoperability, homeland defense) are identified, JDEP will provide a resource
  - **Added, specific investments are likely in these areas**
  - **These will be handled in a similar manner with new capabilities adding to a growing reusable asset base**

Relationships Among
HWIL/SWIL, Simulations and Ranges in JDEP

JDEP as Part of a Larger 'Toolbox'

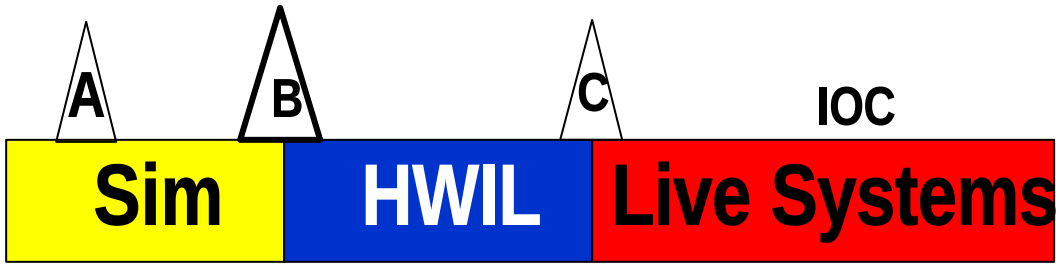
- This strategy focuses on use of JDEP to support users, however it is important to explicitly recognize that JDEP
  - **is part of a larger set of capabilities available to developers, testers, and war fighters to address there full range of needs**
  - **addresses a subset of those needs where system level, HW/SWIL capabilities are needed to address specific issues**
- As noted earlier, analytic tools and simulations
  - **are used early in the life cycle to address many of the issues JDEP can support once an end item has been created, and**
  - **will continue to be used side by side with JDEP**
- Simulations, both man-in-the-loop and constructive, are also used throughout the life cycle
  - **to support a number of areas, including concept assessment, operations plan assessment and mission rehearsal and training**
  - **JDEP assets may be used here when specifics require HWIL capabilities**

The 5000.1 Acquisition Process



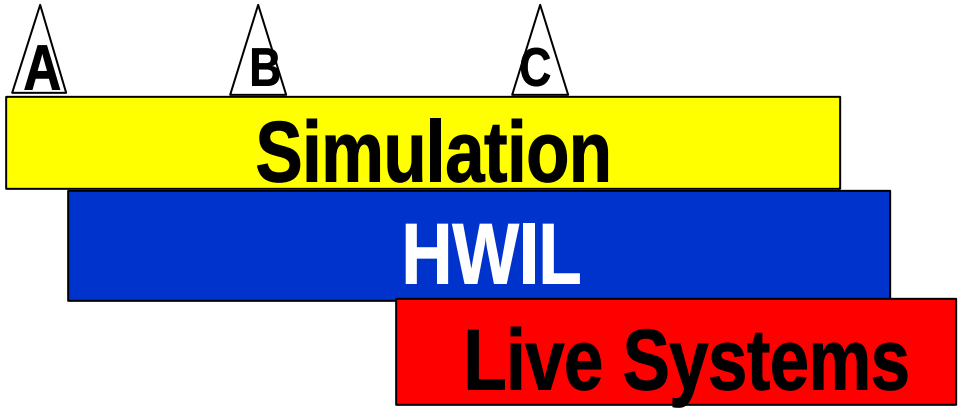
- *Process entry at Milestones A, B, or C (or within phases)*
- *Program outyear funding when it makes sense, but no later than Milestone B*

Sequential Use



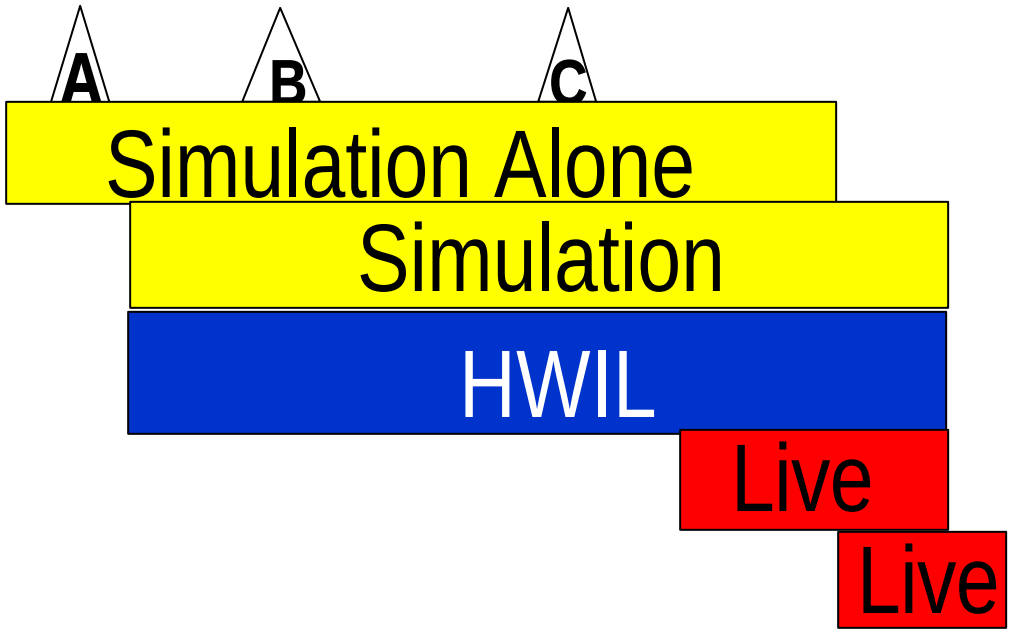
- Traditional view for product development is that simulation, HWIL, and then live systems testing are used in sequence

Concurrent Use



- SBA strategy suggests hardware prototypes and live testing should be minimized and focused on critical issues, and simulation used to maximum extent possible.
- In this case, simulation is used throughout the life cycle, concurrently with other approaches.

Mixed Use



- With SoS development, there is the added issue of addressing issues of how a system works in the context of other systems, at key points throughout life cycle.
- This means that simulation is used in the context of both HWIL and live testing, to address SoS issues.

Implications for JDEP

- To allow a system developer to readily employ JDEP as part of a systematic lifecycle process incorporating the full range of tools, there are implications for the way JDEP structures
  - technical infrastructure standards
  - practices/processes
  - supporting capabilities and tools

JDEP Technical Infrastructure Standards

- Interoperability standards
  - To implement the concept of mixed and concurrent use of simulations, HWIL facilities and linkages to live systems, requires use of a common framework for ‘technical’ interoperability among potential federate ‘types’
  - Best fit candidate today is TENA, which is designed for this purpose
- Data exchange standards
  - Beyond this, if PMs are to be able to reuse capabilities across federations with ‘different mixes’, a common set of at least basic data exchange standrads will be needed

JDEP Practices/Processes

- Common process for federation design and execution
- Consistent VV&A practices
- Common security certification process

  – Further, common processes will be needed for federation development, VV&A, and security certification, if a user is going to be able to assess his problem, pick the right mix of federates of the right ‘type’ for the problem at hand, and not have to adapt the way business is conducted for each problem based on the solution set

Supporting Capabilities and Tools

- Multiple ‘interchangeable’ systems representations
  - Ideally, there would be representations of systems available of different federate types (simulation, HWIL, range-based) to select from, depending on the nature of the users problem and availability of assets
  - Also, ideally, there would be general visibility across ‘types’, so a user could identify the options from a common information source
- Shared supporting tools
  - Tools supporting common functions should be useable across federations incorporating different federate types

Supporting Capabilities and Tools (Concluded)

- User metrics
  - Common sets of user metrics need to be applicable to events conducted using federations with different mixes; allowing for cumulative understanding of underlying processes across events
  - Single Integrated Air Picture (SIAP) Systems Engineer metrics efforts is a good example
- Reusable, persistent federations
  - In a mission area, we can expect to see ‘persistent federations’ of systems which are used over time, along common scenarios and databases to address mission area development

Challenges

Challenges

- "Under the JDEP Umbrella"
  - What does it mean to be 'part of JDEP'?
- JDEP Technical Migration and Expansion
  - Can we develop and apply common technical standards, processes and tools for a comprehensive 'composite' DOD SoS integration and test infrastructure?
- DOD SOS Policy/ Management Context
  - Too Early or Too Late?

Under the JDEP Umbrella

- What does it mean to be ‘part of JDEP’?
  - JDEP concept is that assets owned by others will be shared for reuse in federations to address new issues
  - JDEP provides coordination and technical services to enable this
  - JDEP does not ‘take over’ the assets or events, rather partners with users to create events which meet their needs
  - Challenge
    - Resource sharing requires cooperation and trust
    - Resource scarce environments require this type of collaborations
    - Organizational competition for funds and control need to be balanced with the benefits of cooperation and sharing
    - Recognizing in SoS issues one organization cannot do it all

JDEP Technical Migration and Expansion

- Can we apply a robust common technical framework across the composite DOD SoS development and test infrastructure?
  - Different organizations (NDEP, JNTF, BMDO, others) have developed different ways to configure systems for SoS integration and test
  - As long as the driving issues reside within the original domains, the separately developed approaches suffice
  - However, by it very nature SoS requires ‘mixing’ systems across domains
  - Challenge
    - Bridging different community approaches to allow for cost-effective creation of federated environments to address SoS of today and tomorrow
      - technical feasibility and affordability

Too Early or Too Late?

- How does JDEP fit into today's DOD SoS policy context?
  - Good testing depends on good, testable requirements
    - **Need for articulation of SoS interoperability beyond individual system-by-system requirements**
  - Despite progress, beyond JTAMD there is little organization or policy on 'family of system' definition of interoperability, suggesting
    - **The needed foundation is lacking, and JDEP is too early**
  - On the other hand, current needs to address SoS are growing and users seek environments to address these issues now, suggesting
    - **They cannot wait but must build these themselves, JDEP is too late**
  - Challenge
    - **Cooperatively create capabilities to meet current needs, using a common technical framework**
    - **Coordinate and share resulting capabilities through JDEP so they can be cumulated and shared for future uses as they emerge**

Questions for Industry

Role for Industry in JDEP

- JDEP ‘Suppliers’?
  - Provide system JDEP ‘nodes’
    - **Supporting Government systems?**
    - **Independently?**
- JDEP Event Conductors?
  - Conduct events for JDEP users working with coordinator
- JDEP Users?
  - Using JDEP to assess issues
    - **Supporting a DOD customer?**
    - **Independently?**

Current Industry Practices

- How does industry current address product interoperability?
- How does JDEP fit?
  - Natural complement?
  - In conflict?
- What does industry practice suggest for JDEP straegy and concept of operations?

Definition of Technical Framework and Tools

- Ideally the JDEP ‘plant’ will be based on industry standards and supported by commercially available products
- What role should industry plan in definition of the framework?
- Ideas about product selection?
- What are best available mechanisms for industry to participate?

Discussion

Conclusion

- JDEP is here, and is counting on all of you, to contribute as
  - Users
  - Suppliers
  - Event conductors
  - Technical partners
- SoS war fighter needs are here today
- JDEP is ready to work with the industry to create the infrastructure needed to meet the SoS challenges of today and tomorrow